High Power RF Systems, Control and Distribution in the HINS

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Fermilab Accelerator Advisory Committee
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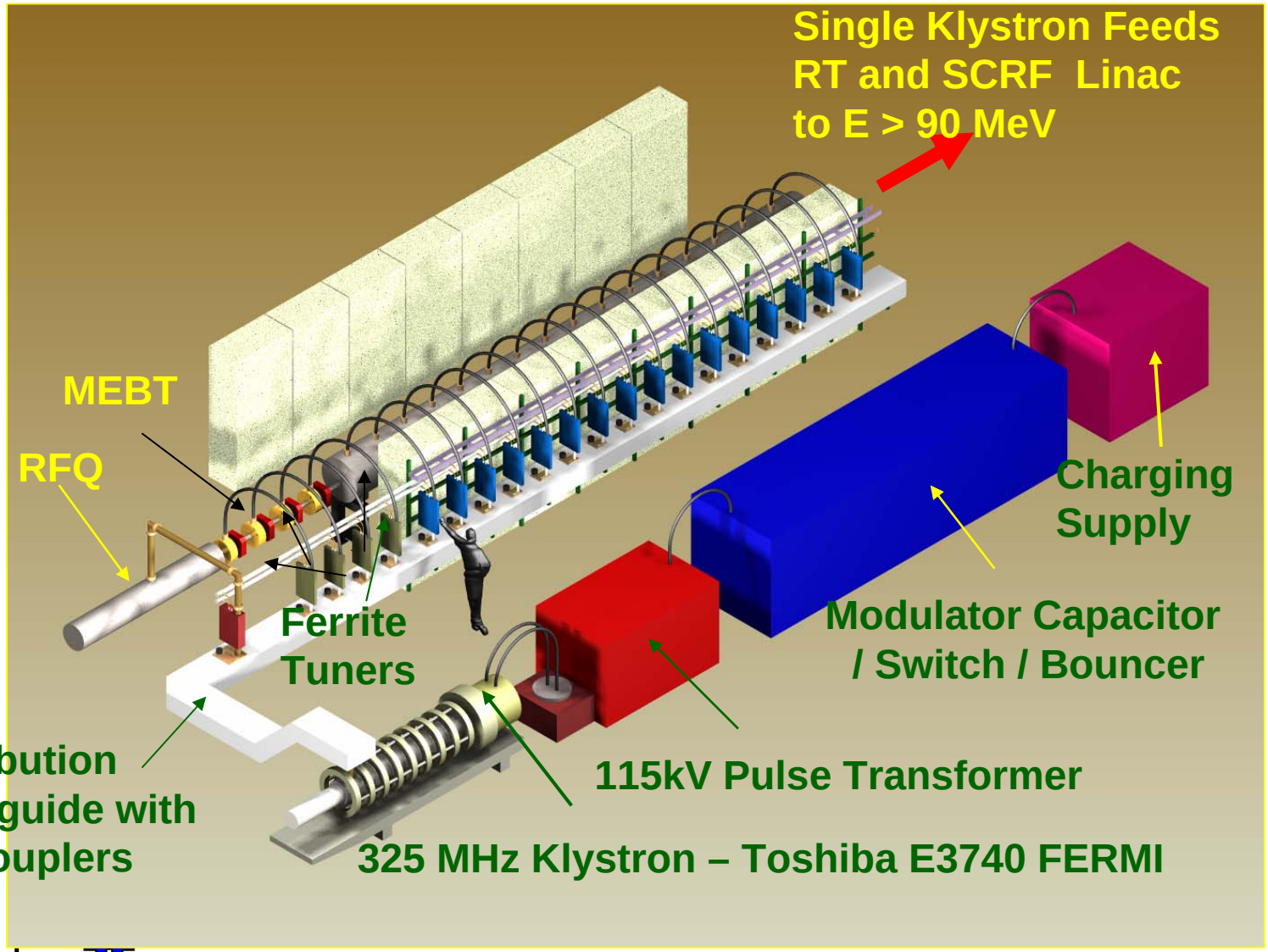
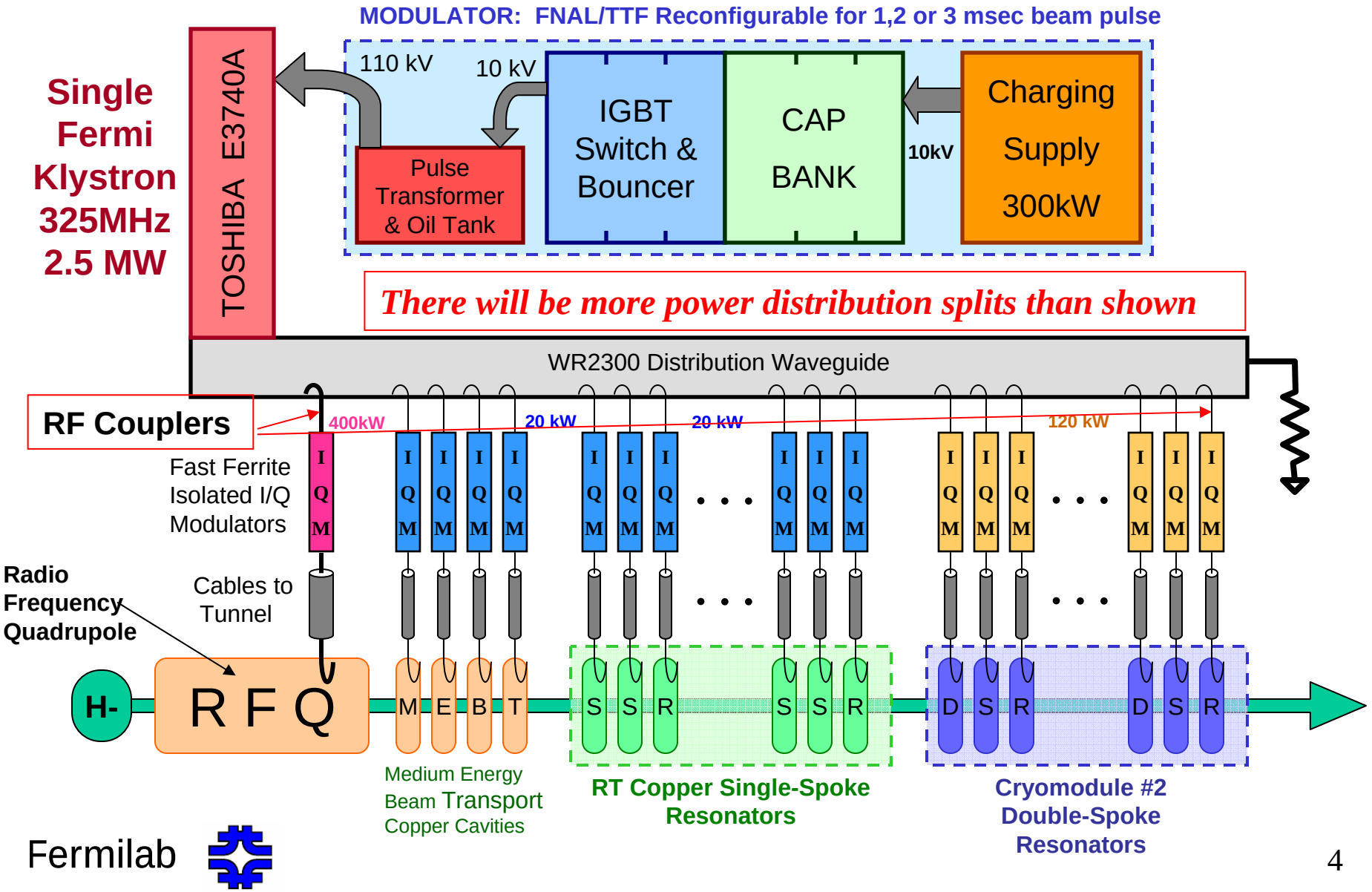
Outline

- Genera description of Fermilab High Intensity Neutrino Source (HINS) Linac
- Description of (HINS) linac R&D Study.
- Conclusions.

HINS 325 MHz Front END



325 MHz RF System



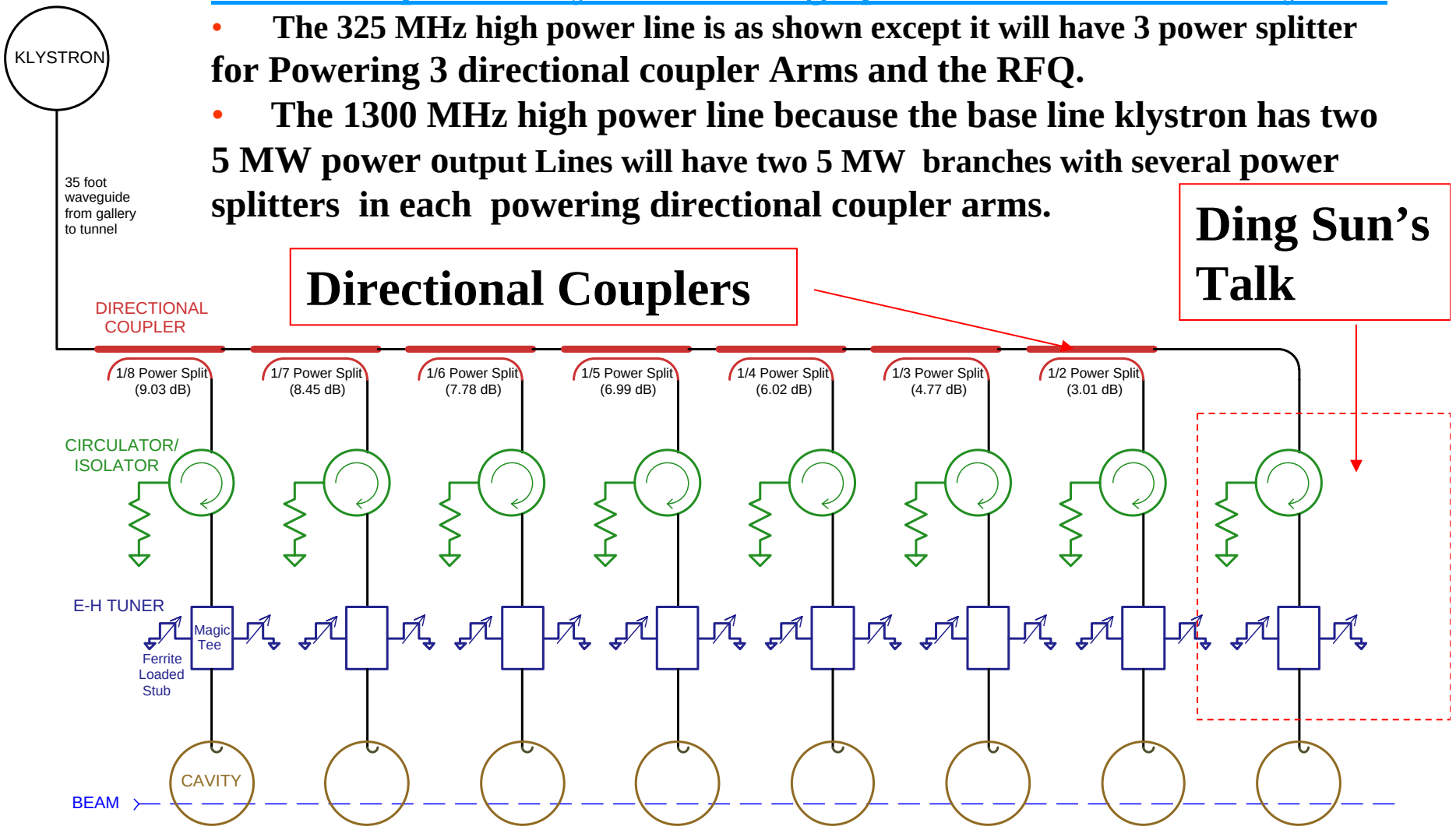
Simplified Layout of the RF Fan-out for 8 GeV HINS Linac

This is simplified Layout of the high power RF distribution system

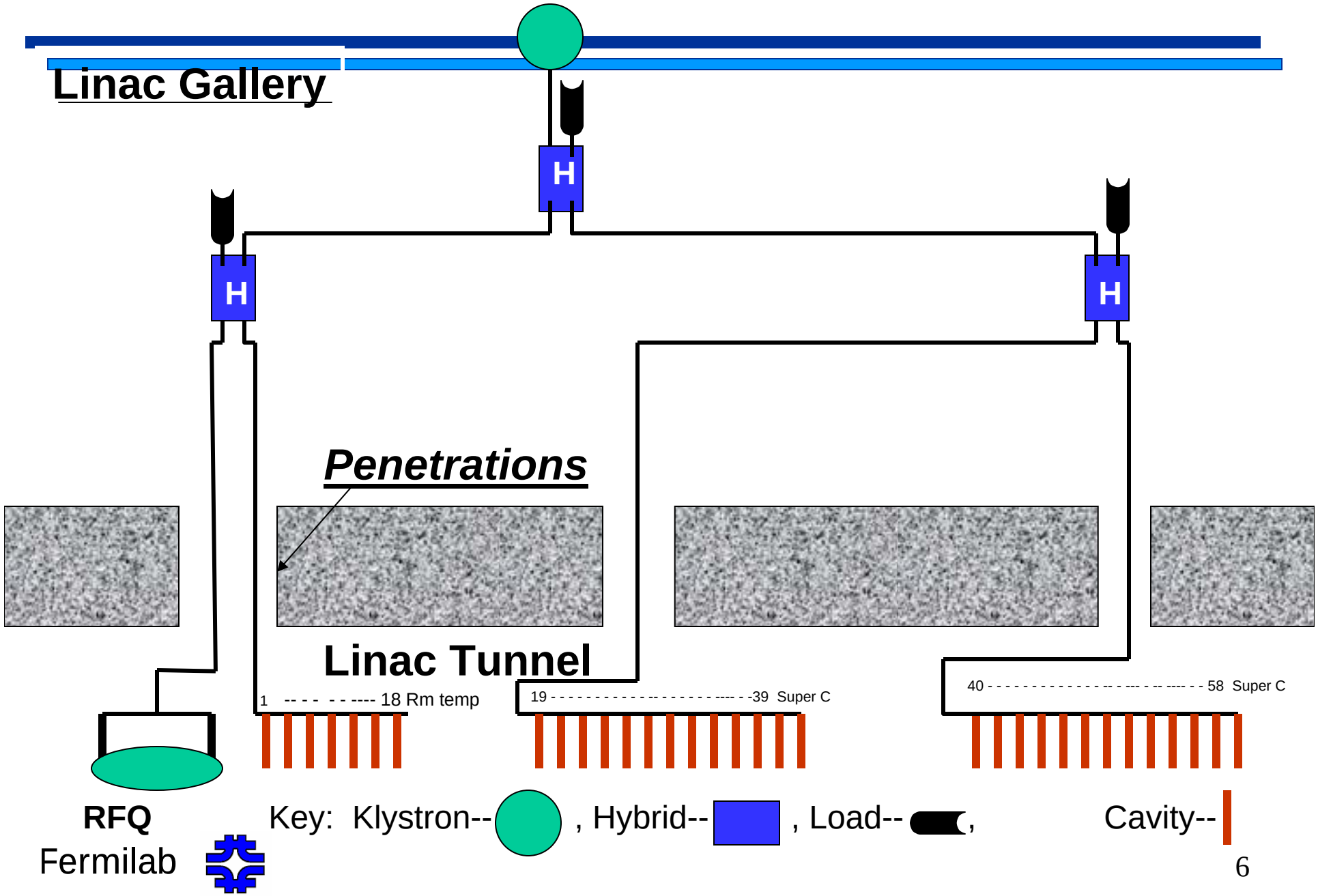
- **The 325 MHz high power line is as shown except it will have 3 power splitter for Powering 3 directional coupler Arms and the RFQ.**
- **The 1300 MHz high power line because the base line klystron has two 5 MW power output Lines will have two 5 MW branches with several power splitters in each powering directional coupler arms.**

Directional Couplers

Ding Sun's Talk



One 325 MHz Klystron Driving 58 Cavities and RFQ

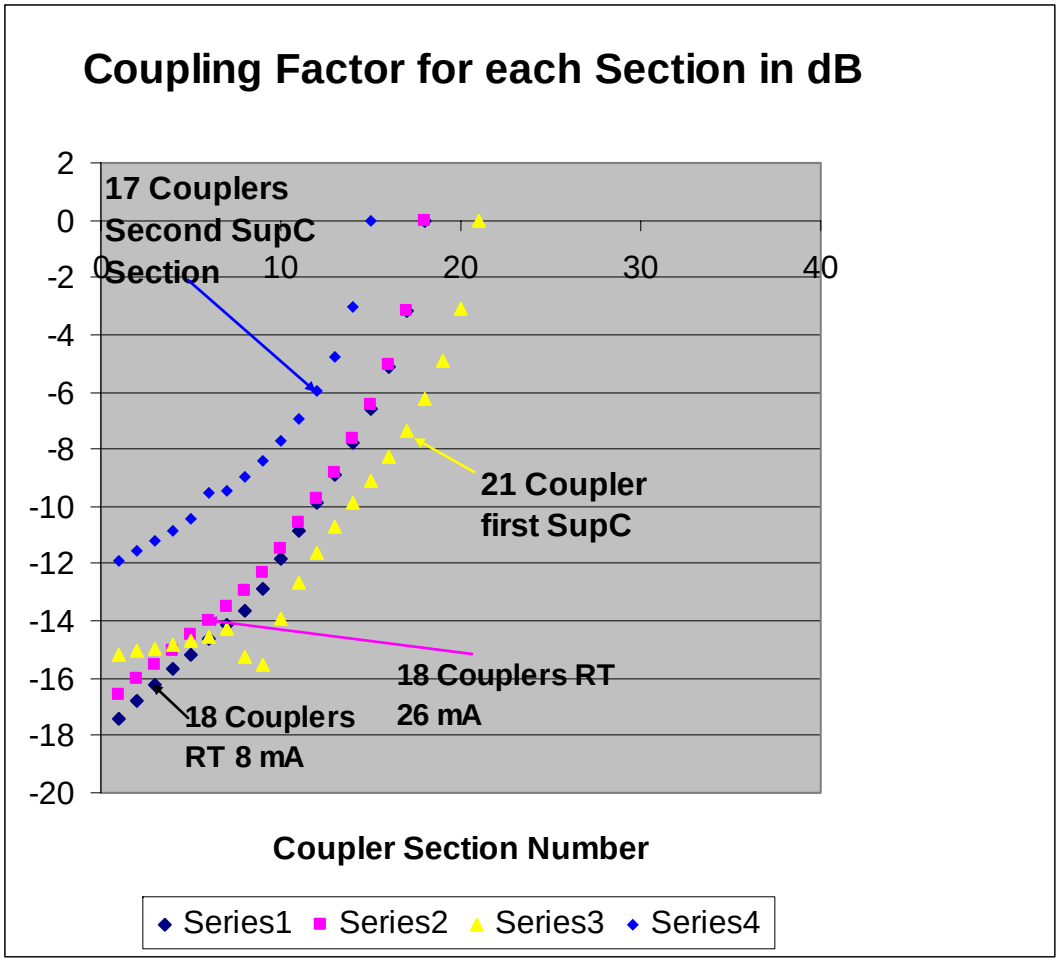


Status of Required Components

- **Vendor quotes have been received for the required hybrid power splitters.**
- **Vendor quotes have been received for the string of directional couplers required to provide RF power to the cavities.**
- **In-house studies of directional coupler strings using HFSS is underway.**

Directional Coupling Factors along the 325 MHz section of the HINS Linac

- The chart shows that the Superconducting cavity coupling factors remain constant with changes in beam loading (Blue and Yellow curves).
- The red and black curves show the coupling factor change with beam loading with beam loading changes.



HINS 325 MHz Klystron

Specifications:

Beam V= 98 kV

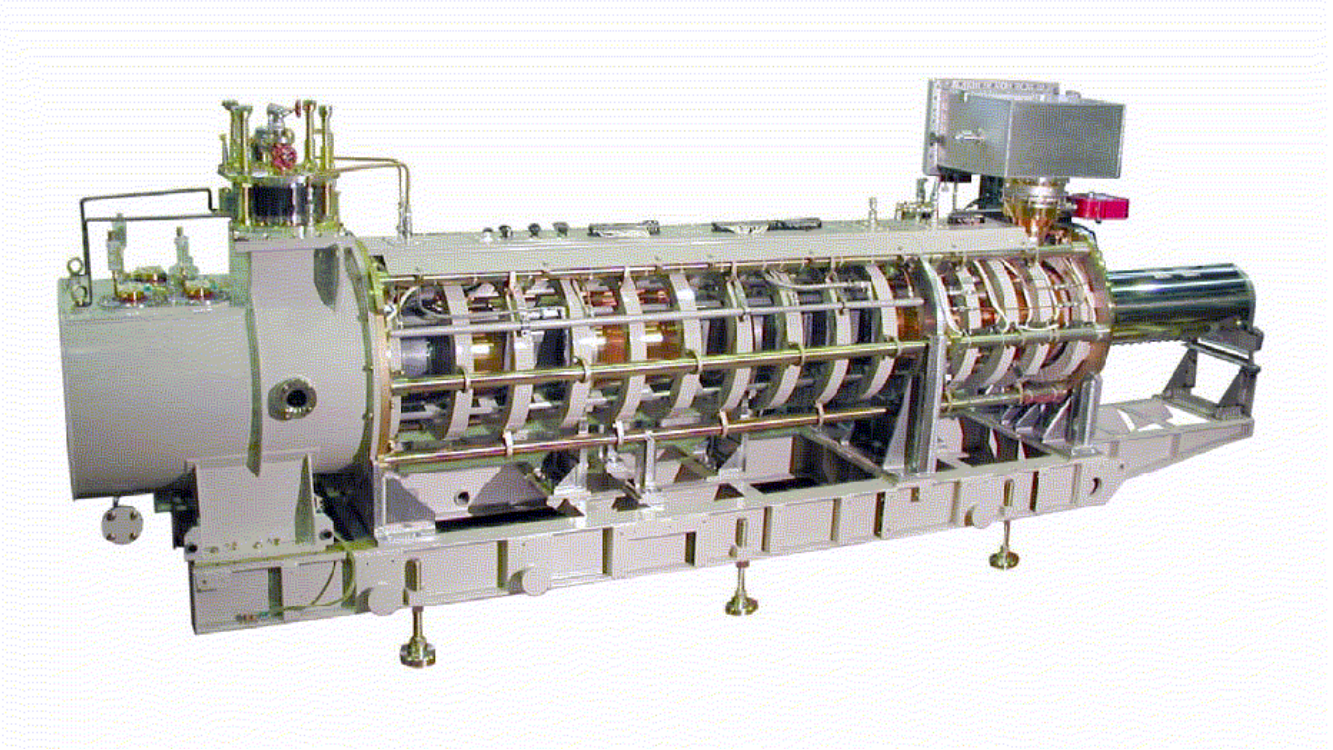
Beam I= 51 A

Perveance=1.75uP

Gain= 47 dB

Efficiency=50 %

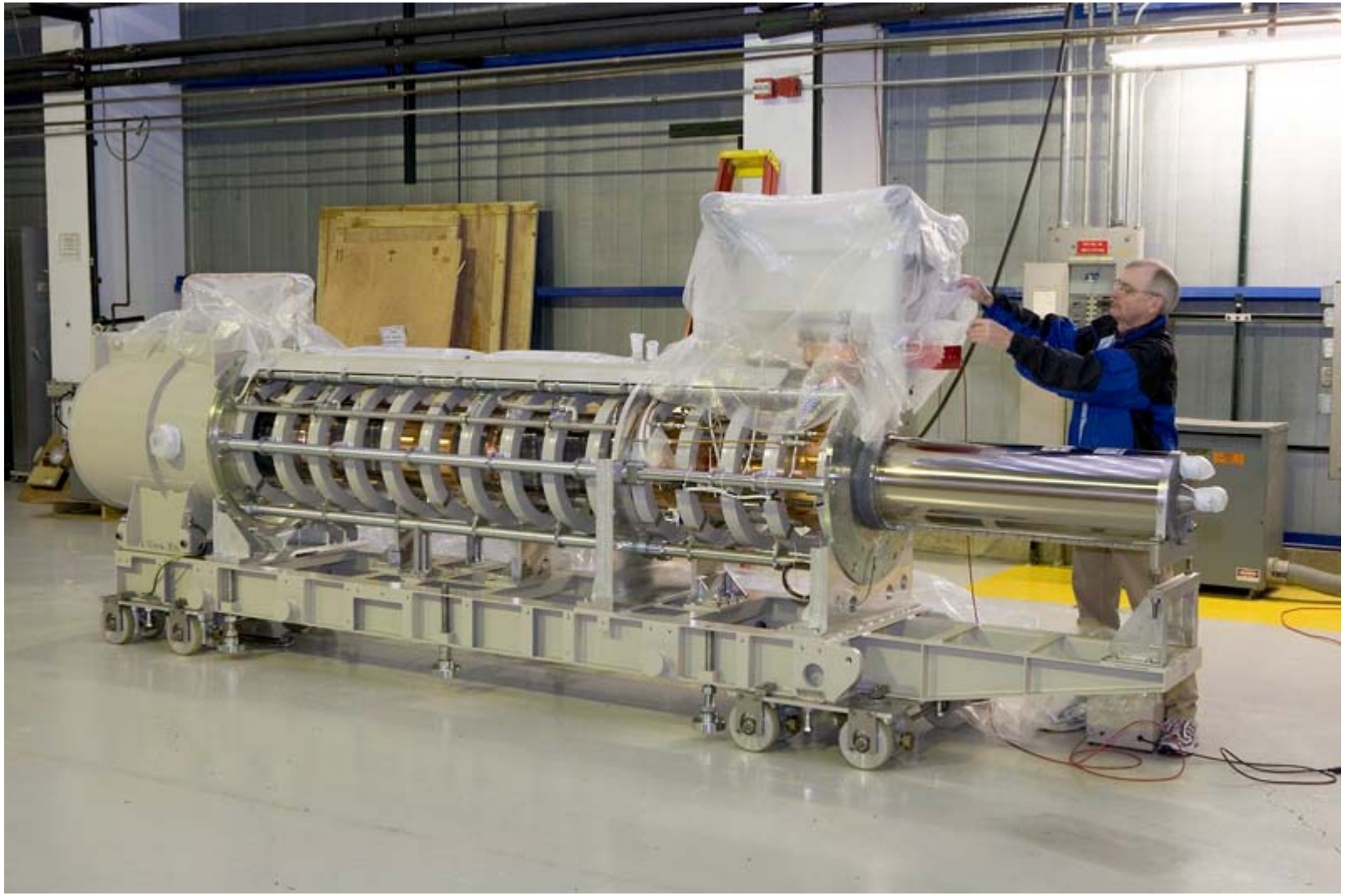
Modulating Anode grounded to make a diode tube.



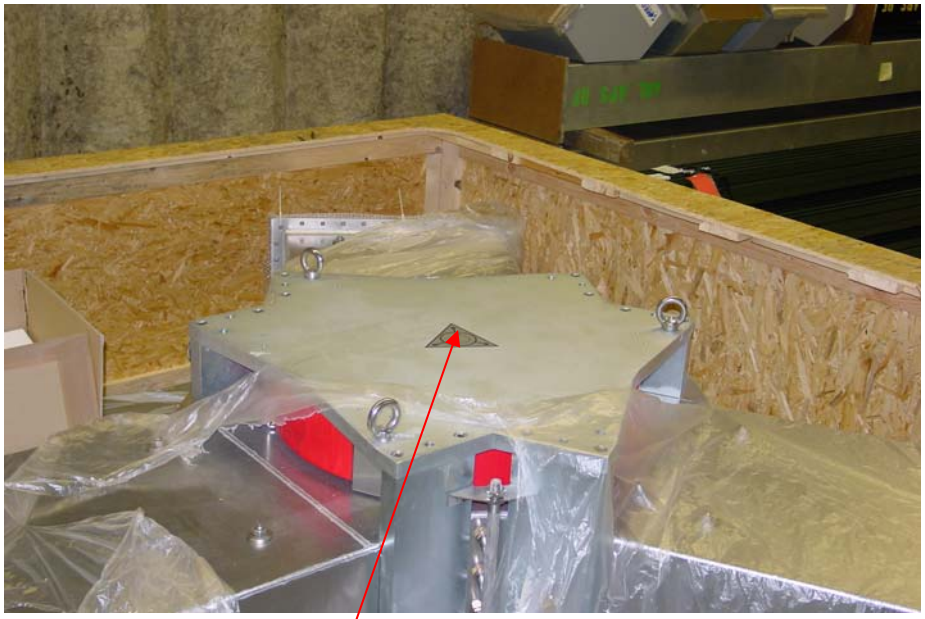
Toshiba E3740AFermi

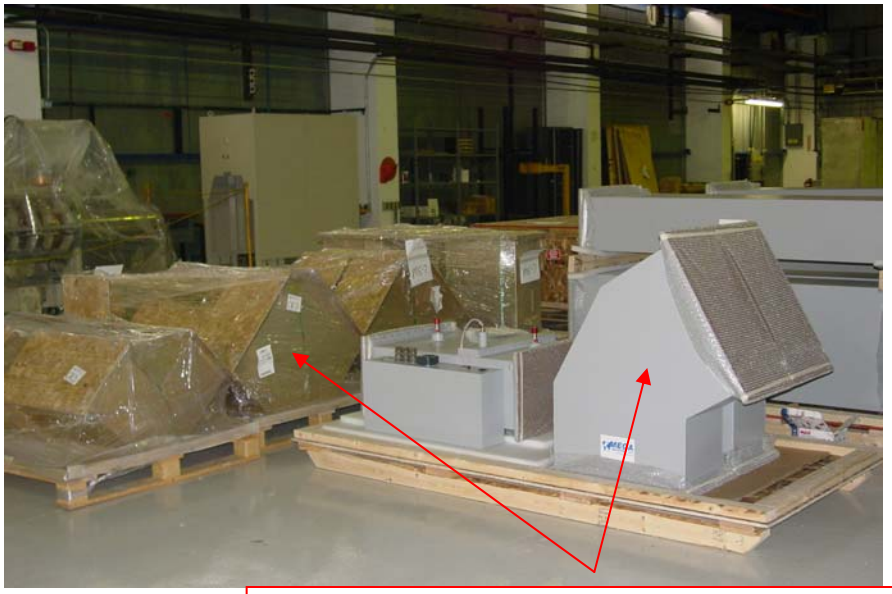
325 MHz 2.5 MW

325 MHz kltsron in Meson Building on its wheels.



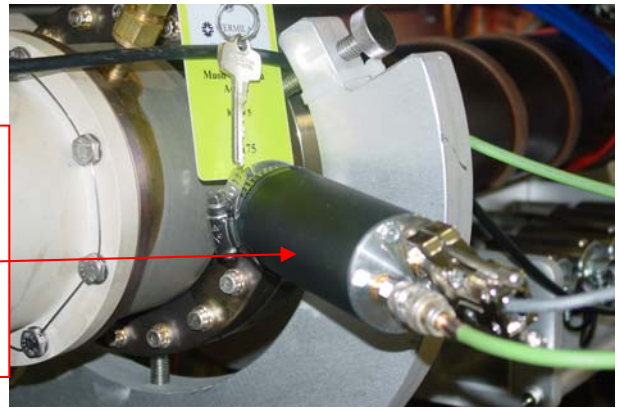
325 MHz Components





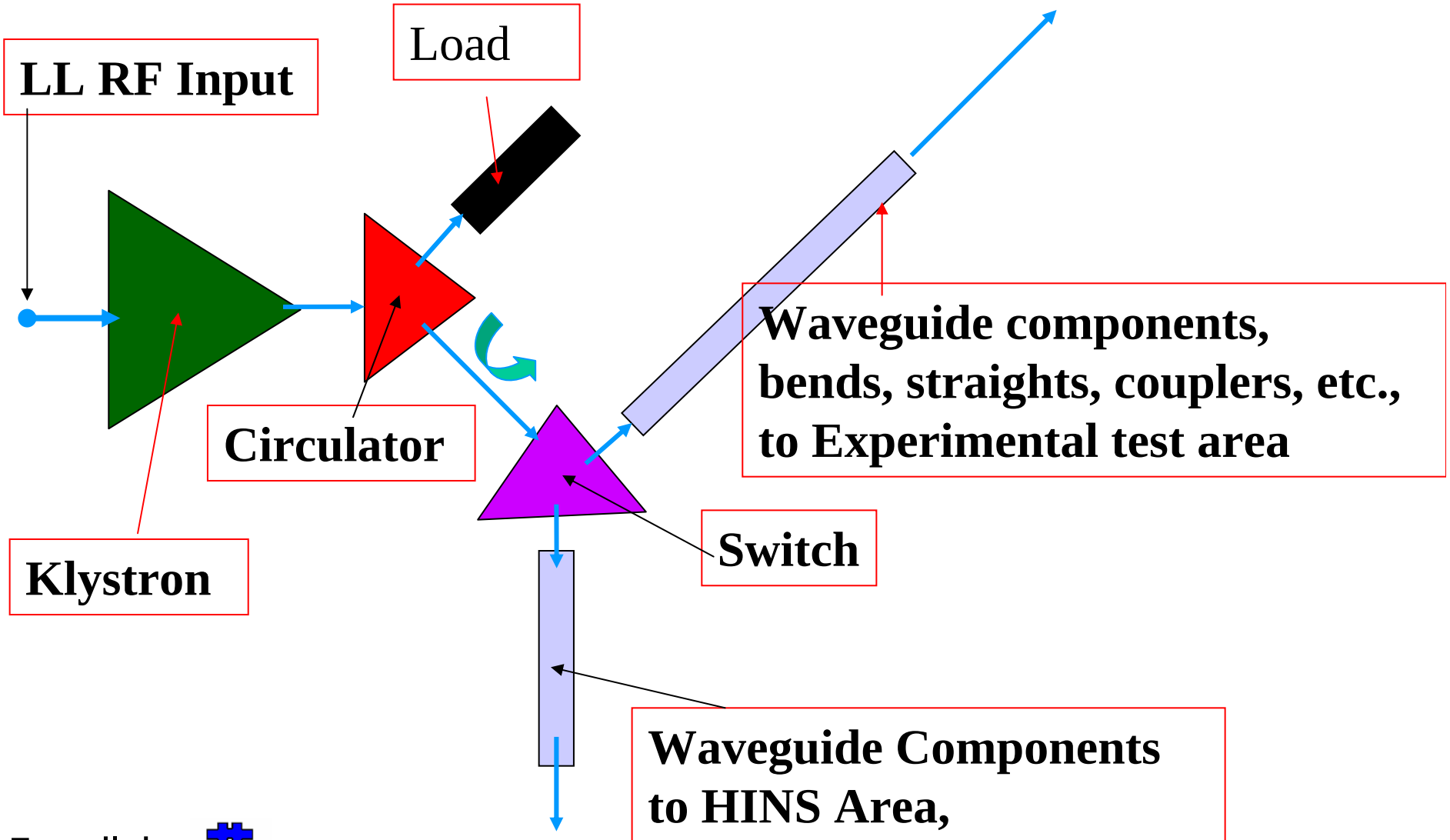
Circulator

Modern Photo-multiplier for Arc detection

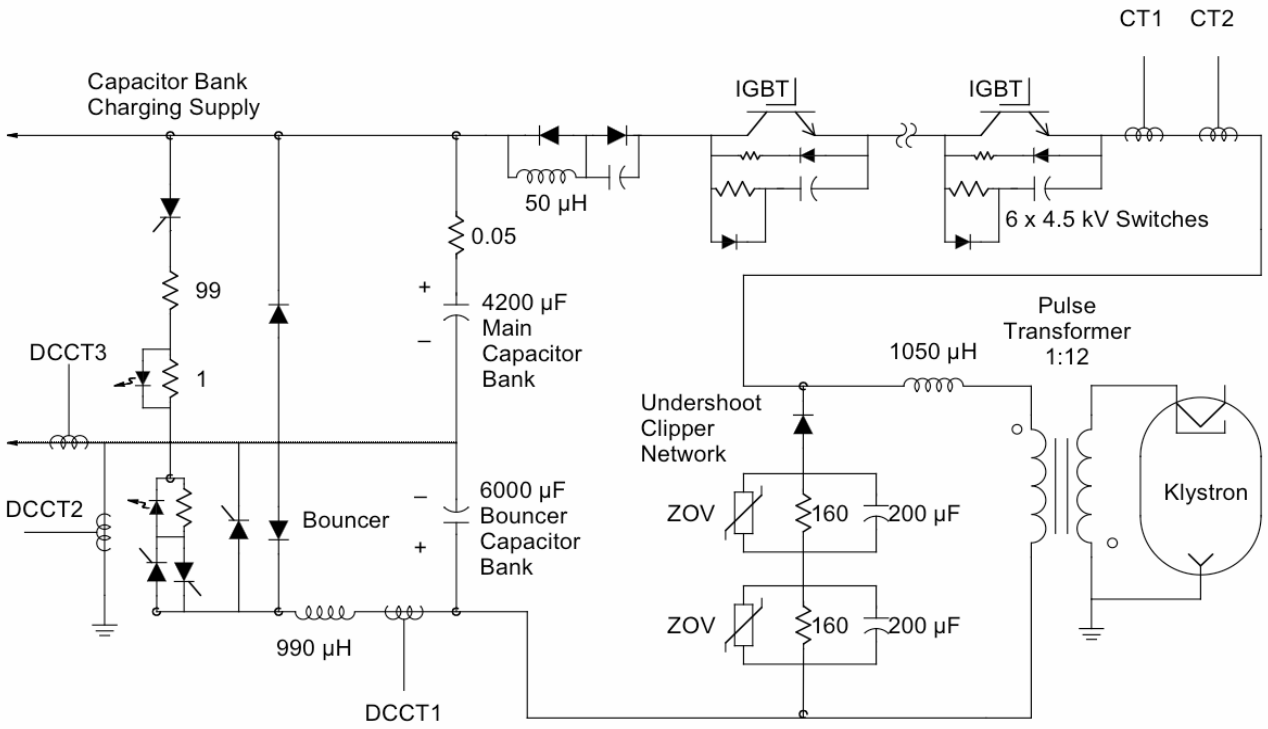


Miscellaneous required RF Components: Bends, Couplers, Bellows, straight pieces,etc.

LAYOUT OF Test and HINS Area

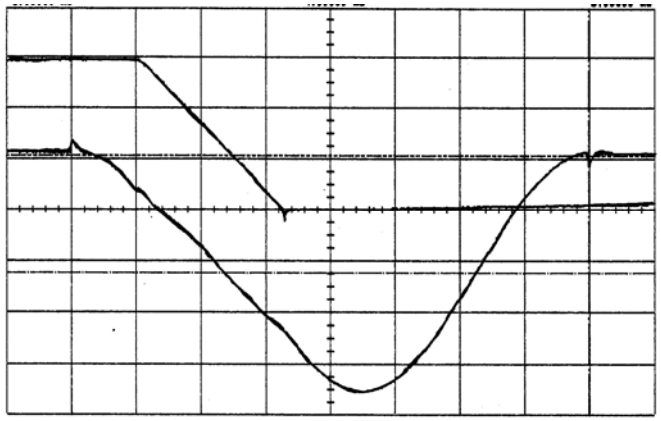


Bouncer Modulator Circuit

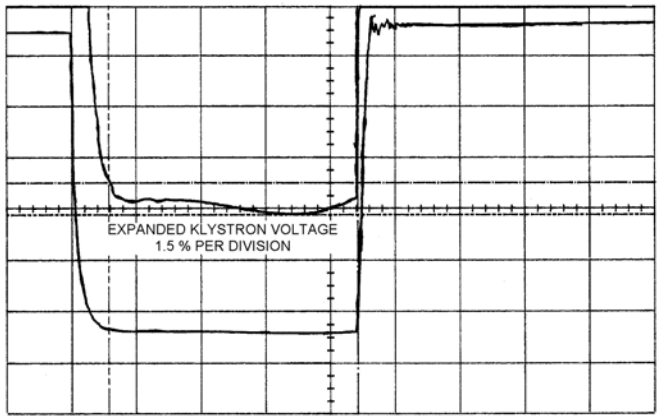


Bouncer Modulator Waveforms

- **Switch connects main capacitor bank to transformer during pulse.**
- **Transformer steps up voltage to 120kV/130A (12:1)**
- **Main capacitor bank discharges by 20% during pulse**
- **“Bouncer” circuit compensates for cap bank droop.**



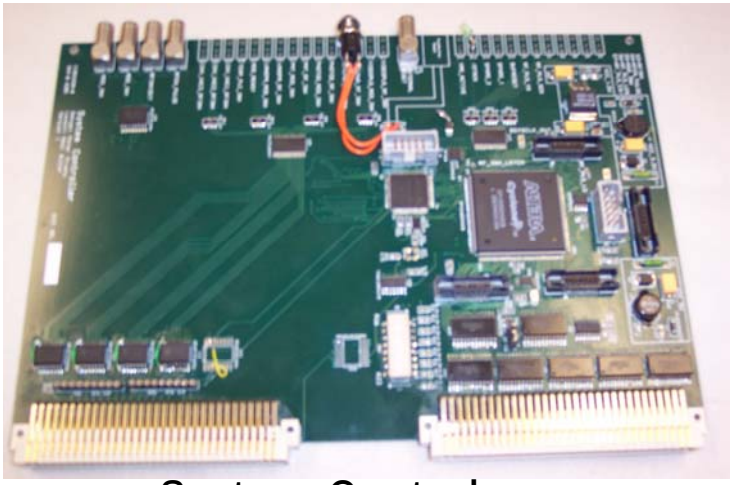
Main Capacitor and Bouncer Capacitor Voltage



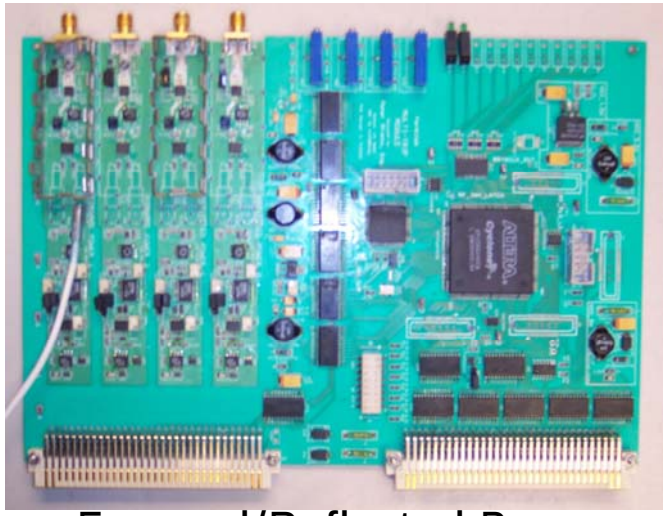
Klystron Voltage and Expanded Klystron Voltage

Pulse Transformer 4 ms Pulse Length for HINS

Klystron Protection Interlock Boards



System Control



Forward/Reflected Power

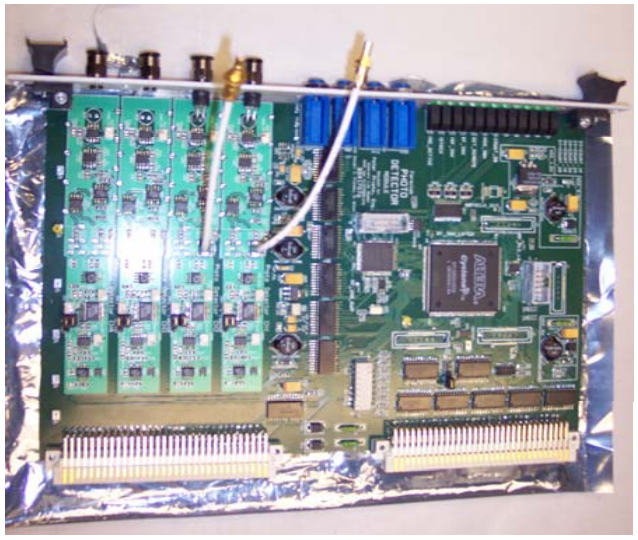
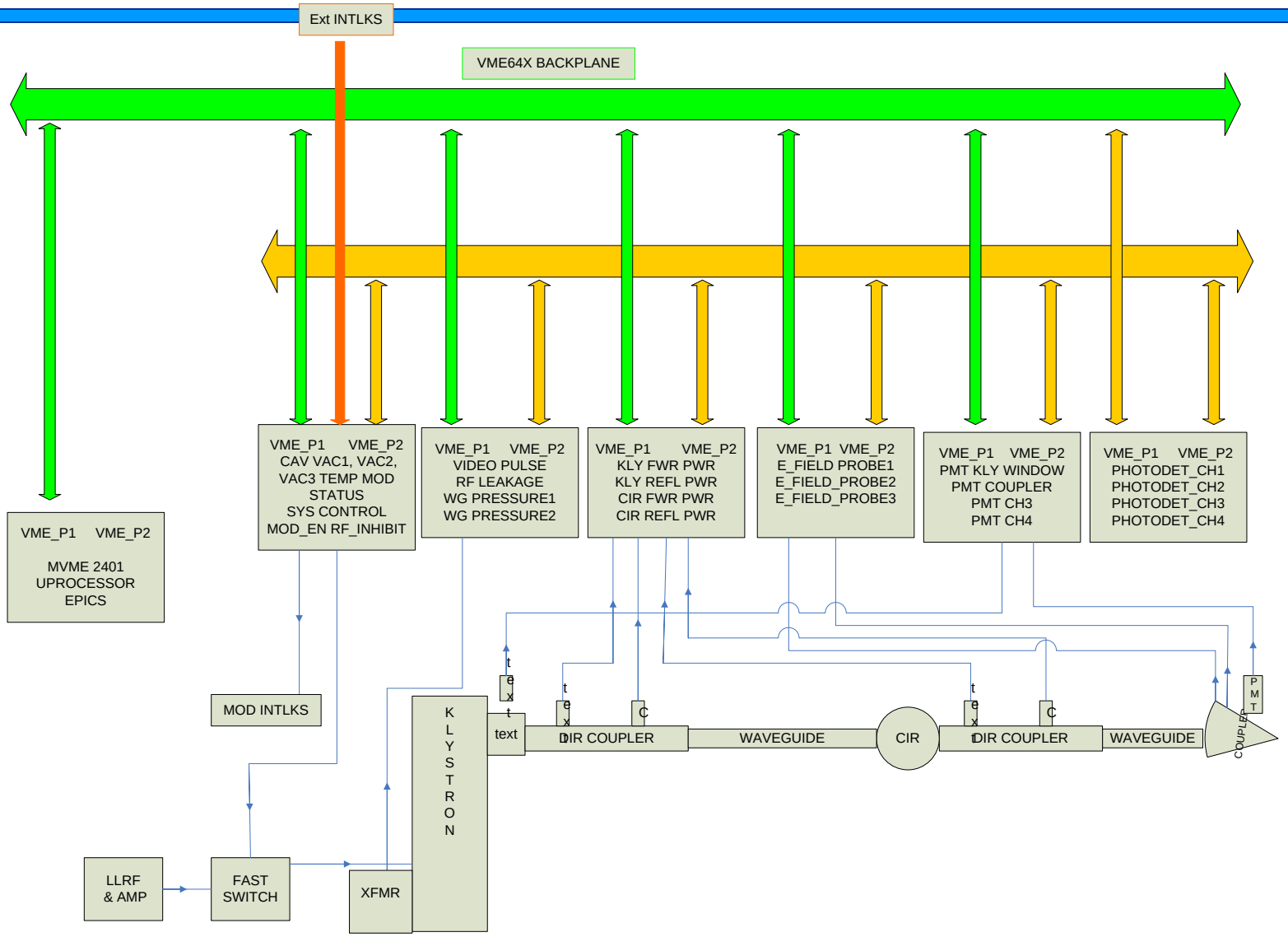


Photo Detector

Video Pulse

HINS and SMFT Interlocks



Conclusions

- **All of the components for the 325 MHz klystron output RF power testing are on-hand. First RF power testing of 325 MHz klystron is scheduled for July of this year.**
- **Major Components of the modulator are on hand and testing of major assemblies is underway.**
- **Design of the of the equipment and safety interlocks has been completed. Construction and assembly and testing of the boards are underway.**
- **Conceptual design of the low level RF system has started in collaboration with LBL . Adaptations of In-house, Desy and SNS prototype control boards are under study .**